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ORR POSITION ON SOVIET MANNED LUNAR LANDING PROGRAM

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CENTRAL INTELLIGENCE AGENCY

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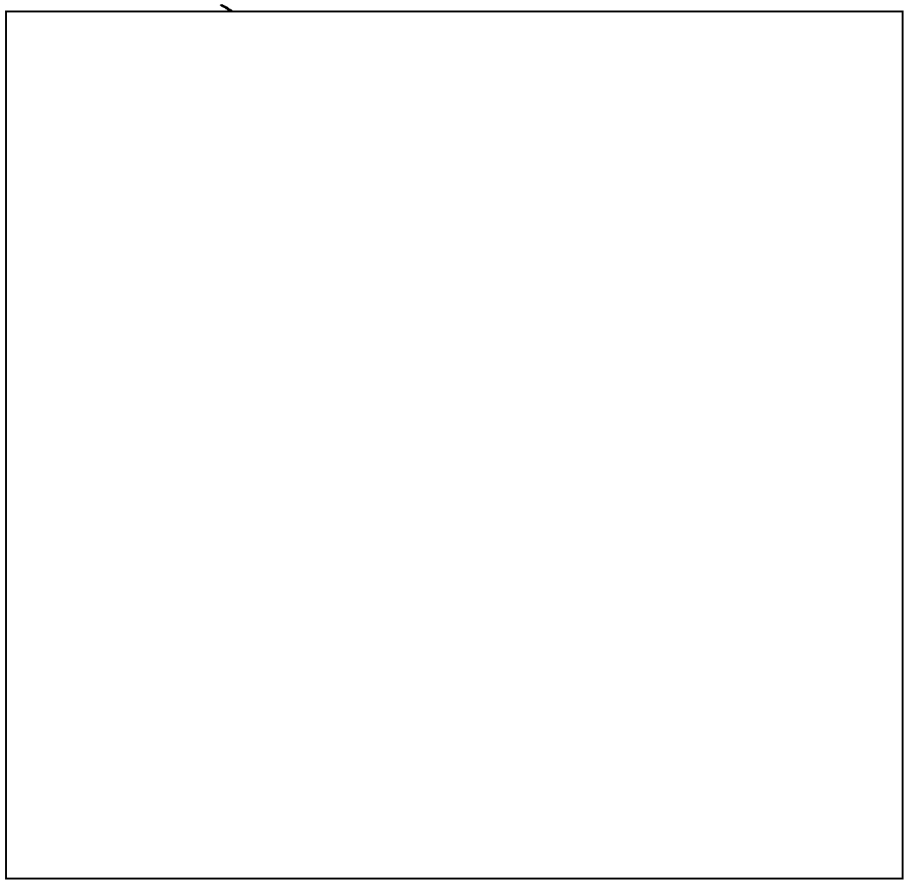

FOREWORD

The purpose of this ORR position paper is to provide background information for the forthcoming USIB consideration of the need for a Memorandum to Holders of NIE 11-1-62 on the subject of a Soviet manned lunar landing program. In this paper, we have undertaken to present and discuss only that portion of the evidence and those considerations which bear most directly and most importantly on our judgment. The information presented in this paper is current as of 14 February 1964.

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SUMMARY

Current evidence on the Soviet space effort does not permit firm conclusions to be drawn concerning the status of a manned lunar landing program and is not an adequate basis for judging whether it is competitive with the US program, or indeed whether such a program even exists in the USSR. The strongest indication that a very large booster capable of performing this mission is under development and that the Soviets may intend to land a man on the moon in this decade i Tyuratam, where an unprecedented expansion of physical facilities has occurred since the preparation of NIE 11-1-62. Although it seems unlikely that ICBM programs account for all of the new construction. we believe there is a distinct possibility that a very large booster capable of the lunar mission will be forthcoming and perhaps an interim space booster as well. ment at a new supp

no new installations which can be clearly associated with development of a very large booster. However, we have no assurance that such installations will be required and our evidence is not sufficient to rule out the use of existing facilities for this purpose. The only other body of evidence available, Soviet statements, suggests that the USSR is engaged in a manned lunar landing program, but gives no clear indication of its time phasing or current status.

It is clear that the Soviets have not accomplished many of the missions which would be prerequisite to a manned lunar landing. However, our analysis of a reasonably paced Soviet lunar landing program for 1969 indicates that no identifiable program milestones need necessarily occur before about 1966, other than construction at Tyuratam. Since we have no means of identifying such activity prior to the flight test phase, we believe that the absence of a high level of activity up to this time should not be interpreted as a negative indicator of Soviet intent or capability to compete.

We have reviewed again the likely effect of economic considerations upon Soviet intentions. There can be no doubt that a competitive manned

lunar landing program would be extremely costly and that economic considerations would have exercised a strong negative influence when the Soviet leaders were considering their response to the US challenge in 1961. However, we do not believe that these considerations would necessarily have been an overriding factor. The Soviet decision would have depended upon the value the Soviet leaders placed upon such a program as a national policy objective relative to competing uses -- military and civilian -- of the same level of resources.

Accordingly, in the absence of firmer evidence than is now available, we believe it is premature to make a confident judgment regarding Soviet intentions to achieve a manned lunar landing in this decade. If [redacted] indicates that a booster capable of accomplishing this mission is being developed, we should be able to judge with a fair degree of confidence by late 1965 or early 1966 that the Soviets are competing. On the other hand, if [redacted] it could probably be safely concluded that the USSR would not be capable of accomplishing the lunar objective by 1970.

I. Evidence on Soviet Intentions to Land a Man on the Moon

At present, three main bodies of evidence are available to us --

and statements by leading Soviet personalities.

TTMTR Launch Facilities. Since NIE 11-1-62 was prepared in late 1962, an unprecedented expansion of the physical facilities at Tyuratam has been undertaken. Although some of the new facilities were in an early stage of construction at the time of that estimate, the bulk of the new construction was begun during 1963. This expansion includes the construction of three new launch areas (H, G-1/G-2, G-3/G-4), the addition of two major new buildings and a number of lesser structures to one of the original Tyuratam launch facilities (Complex B), and the preparation of a large new construction support facility (between Complexes A and E) which may be intended for another new launch complex.

In the past, the appearance of new launch facilities at Tyuratam has regularly foreshadowed the initiation of new programs, concerning which we had no prior knowledge or evidence. These programs have involved either new vehicles or new deployment configurations for existing vehicles. Detection of such facilities at Tyuratam has not only provided our earliest indications of forthcoming programs but has also enabled us to determine at least their general nature by analyzing the facilities under construction and their apparent relationships to existing facilities. In general, however, we have been unable to specify in detail the characteristics of new vehicles until well after flight testing was initiated

At present, we are limited in our ability to interpret the significance of the expansion of facilities at Tyuratam,

However, we believe some general conclusions can be drawn with a fair degree of confidence on the basis of the physical features of the new facilities our knowledge of existing Soviet ICBM and space systems, and our judgment of likely Soviet requirements. These conclusions are:

(a) No currently operational launch complexes at Tyuratam are capable of accommodating launch vehicles of the size required for a manned lunar landing mission except Complexes A and B, which would require modification. It is known that a second

assembly and checkout building was constructed near the original checkout building at Complex B between about mid-1962 and mid-1963. Construction of another large new building in the launch area was begun at the end of 1962 or in early 1963 and appeared completed by August 1963. This building, which was not rail-served last September, is probably as large as or larger than any comparable building at Tyuratam on a square-footage basis. To date, however, there has been no identified activity associated with Complex B which would account for the construction of these buildings and we have no basis for judging what new program or programs they are intended to serve. There has been no comparable expansion of the facilities at Complex A.

(b) Complex H is probably intended for an ICBM system related to the SS-7, inasmuch as it appeared [redacted] It may be for the new vehicle tested on two occasions in December and January.

(c) The G-1/G-2 launch area of Complex G is probably intended for a new launch vehicle which is more likely to be an ICBM than a space booster. [redacted] if the G-3/G-4 launchers are soft, they are probably intended for a considerably larger vehicle than those at G-1/G-2 because the pad separation distance apparently is planned to be almost twice as great. In fact, past Soviet pad separation criteria suggest a vehicle somewhat larger than the US Saturn I. This would be adequate for a 100-megaton delivery system and a variety of new space missions, but would probably not be sufficient for the manned lunar landing mission. The presence of a single support facility at Complex G suggests that even if the two launch areas are intended for different vehicles they will be closely related.

[redacted]

(e) It is unlikely that all of the foregoing activity is connected with new ICBM programs. If one or more of these facilities is to be devoted primarily or exclusively to space operations, we believe that Complex B and the anticipated launch complex between A and E are the most likely candidates. no basis at this time for excluding the possibility that one or both of these areas is being prepared to develop a very large new booster capable of performing the manned lunar landing mission.

Static Test Stands. Analysis of design thrust capabilities of static test stands in the USSR has failed to provide a basis for judging whether the Soviets are developing a new booster of sufficient thrust for a manned lunar landing program. Indeed, it is still not possible to distinguish with certainty between those stands intended for engine tests and those for the entire stage.

Current estimates of the capabilities of the known static test stands in the USSR range from about 1 to a maximum of about 5 million pounds thrust. In US practice, test stands are normally not used to full design capability, even though there is a safety margin over and above the design rating. Thus, by US standards, the estimated capabilities of even the largest identified Soviet test stands appear somewhat low for testing the entire stage of a booster of about 5 million pounds thrust, although they are more than adequate for testing large single engines in the million pound thrust class. In view of the uncertainties of the data, however, these judgments cannot be regarded as conclusive.

The largest test stand identified to date is at Zagorsk,

Figure 1

Construction Support Area Between Launch Complexes A and E. Tyuratam Missile Test Range. September 1963

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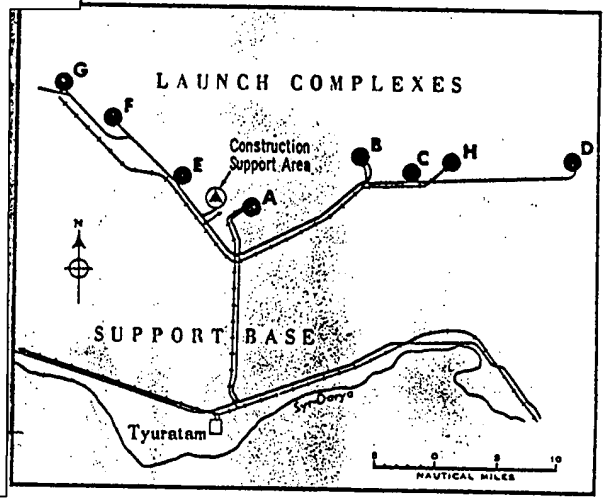

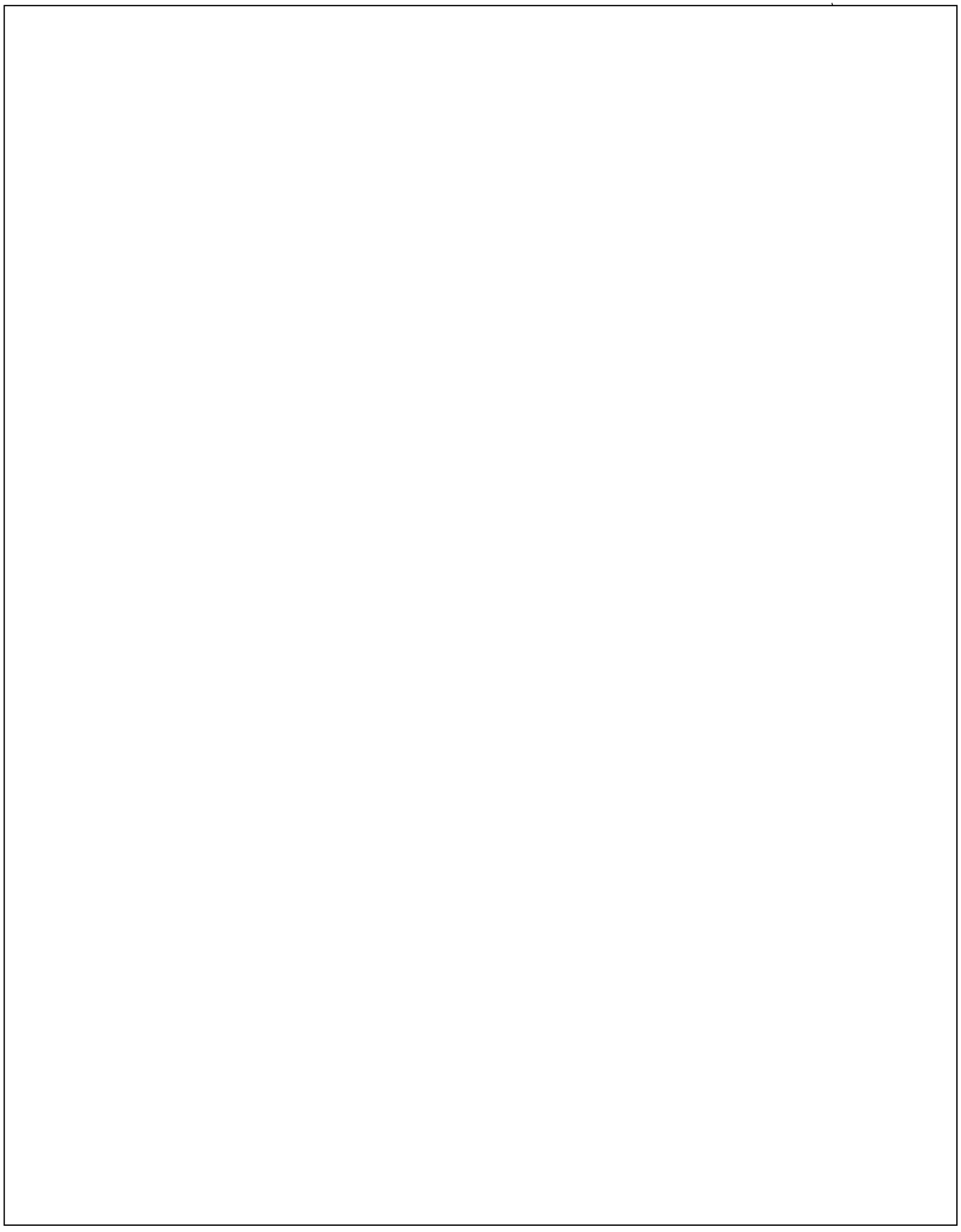

This stand, which was completed in 1956, probably was used initially to test the Category A ICBM booster later may have been used to test the Category C booster

We regard these two installations as the most likely to be used in the design, manufacture and testing of the large booster required for a manned lunar landing mission.

these facilities indicates that no new test stands or other installations have been constructed which, by virtue of their size and the timing of their appearance, might be indicators of the development of a very large new vehicle. However, there has also been no evidence of any major new program at these facilities since and it is likely that a considerable portion of both facilities has been available for new programs for some time. Since even major modifications might not be discernible in the coverage of these facilities to date, we cannot be certain that development of a booster of the size required for the lunar mission is not already underway. Moreover, if the Soviets have chosen to design a booster similar in concept to the Category A space booster, tankage as in the Saturn IC, there might be no need for uniquely large production, handling and testing facilities. Such boosters may well be under development

Statements. Soviet statements provide the only direct indication that the USSR has a manned lunar landing program underway. However, they are ambiguous, conflicting, and of little value in determining the present status of the program and whether it is aimed at achieving a manned lunar landing in this decade.

Khrushchev's statements in the latter part of 1963 concerning a manned lunar landing clearly were intended to create the impression that the USSR is not competing with the US in such a venture. However, it is difficult to judge the extent to which his remarks actually reflect current Soviet policy.

chev's statements indicate that the Soviets have some undefined or

relatively distant target date for whatever lunar landing program is now underway. On the other hand, it seems clear that the Soviets would have little to gain from a public commitment at this juncture to a race with the US, but might benefit substantially from a slowdown in the US Apollo project. It may be, therefore, that Khrushchev's remarks were motivated primarily by a desire to exploit criticism within the US of the scope and pace of the Apollo program. Moreover, the statements are sufficiently ambiguous to admit the possibility that the Soviets might accomplish a manned lunar landing by the end of the decade.

Khrushchev's statements differ markedly in tone from statements made with increasing frequency earlier in 1963 by individuals associated with the Soviet space program. In general, the latter statements implied a Soviet intention to attempt a manned lunar landing within a relatively few years and in several instances had a competitive tone, expressing a desire to accomplish this feat first. Since the Khrushchev statements, however, there has been a notable decline in commentary from other Soviet sources. In the absence of more tangible evidence, we do not believe that Soviet statements assist materially in evaluating Soviet policy regarding a competitive manned lunar landing.

II. An Illustrative Soviet Manned Lunar Landing Program

In the past, evidence has not provided a reliable basis for denying the existence of specific space programs. The situation with regard to a manned lunar landing program is somewhat different, in that the magnitude of this undertaking would require unique hardware and facilities at the test range and possibly at some other space-related locations in the USSR. Nevertheless, analysis of a reasonably-paced manned lunar landing program indicates that a Soviet program to land a man on the moon by 1970 could be underway at the present time without any major milestones being observable other than the initial phases of construction at Tyuratam.

If Tyuratam during the next 18-24 months reveals a launch complex clearly associated with a very large booster, we could probably judge with considerable confidence by late 1965 or early 1966 that the Soviets were engaged in a competitive program. Presumably the Soviets will have accomplished during this period a number of detectable missions which would be applicable to a manned lunar landing, such as additional lunar reconnaissance and rendezvous and docking. These activities would not be conclusive indicators of a competitive program, because they could apply equally to some other objective or combination of objectives. It is our present judgment, however, that the appearance of such a booster during this time period, and the major resource commitment which it would imply, would be more likely to reflect a direct Soviet response to the US lunar challenge of 1961 than pursuit of any alternative space flight objective. On the other hand, if it becomes clear that none of the construction now underway at Tyuratam is intended for a very large booster, and no additional construction is begun in the next year or so which appears to be for this purpose, there would then seem to be little likelihood that the Soviets could accomplish a manned lunar landing by 1970.

By way of illustration, a hypothetical manned lunar landing program is shown in Figure 3.* This program assumes that a decision to proceed with the program was reached by mid-1962 and that the new support area between Complexes A and E is intended to support construction of launch facilities for the manned lunar landing mission. Based on statements by Soviet personalities known to be associated with the

* In general, the timing of specific activities and the relationships between them are in agreement with an early proposal for the Apollo program which was then based on the EOR technique.

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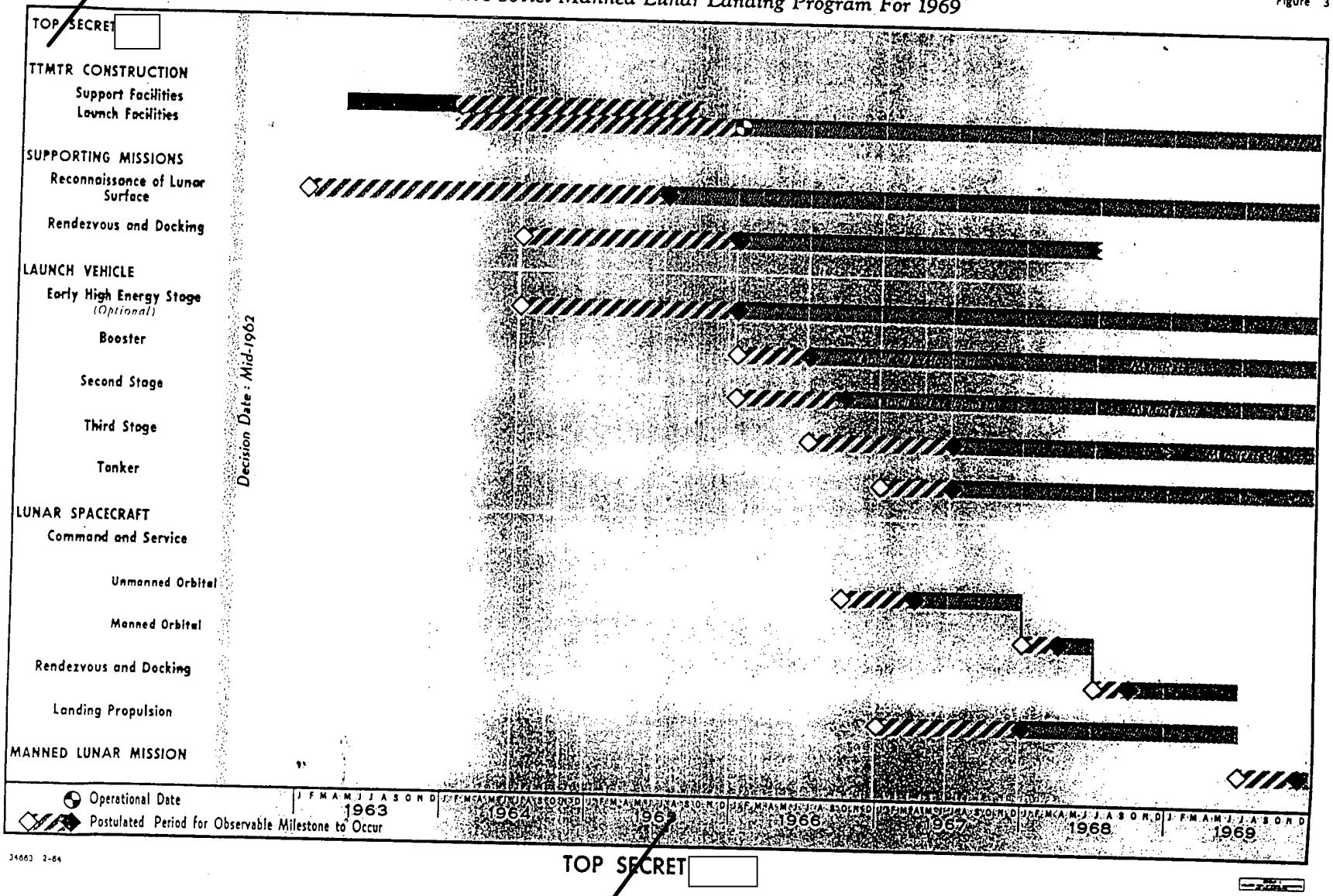
Illustrative Soviet Manned Lunar Landing Program For 1969

Figure 3



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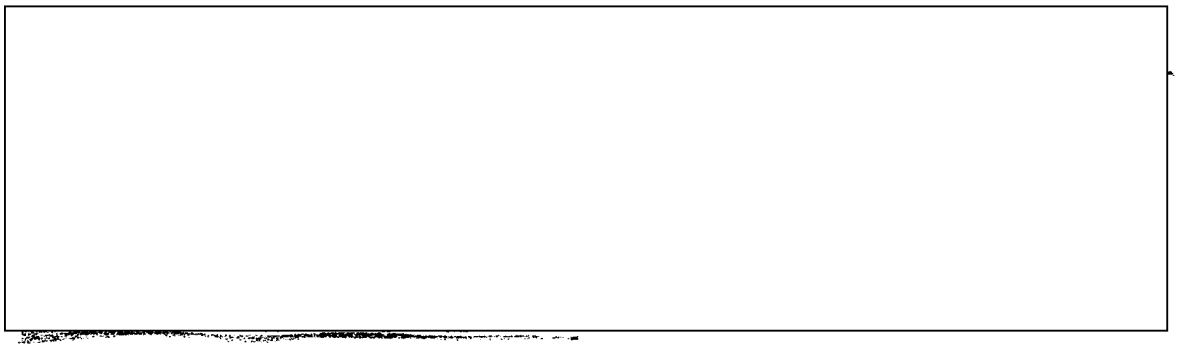
space program, we believe that the Soviets would have adopted an Earth Orbital Rendezvous (EOR) mode.

TTMTR Construction. The estimated two-year construction period for the launch facilities generally is in line with Soviet construction experience observed in the past for large-scale installations at the test range. Launch Complex A required somewhat more than two years to build but did not have the extensive construction support facilities present between Complexes A and E. Launch Complex G, which has a support facility approaching in size that of the new area, has been under construction since shortly before mid-1962. Pads G-1 and G-2 in this Complex have required an estimated 18 months to complete; Pads G-3 and G-4, which began about a year later, were in such an early stage of construction [redacted] that we are unable to make a firm estimate of a completion date. Judging by the status of the construction support facilities between A and E [redacted] we would expect construction of the operations support area and probably the launch area to have started by now. Presumably, the magnitude and general nature of these facilities would be clearly identifiable some time in 1965, if not before.

In the US Apollo program, by contrast, construction of Pad 39A for the Saturn V began in late 1962 and is not scheduled for completion until about mid-1966 -- a period of about 3.5 years; however, almost an entire year has been spent in earth moving operations peculiar to the launch site at Cape Kennedy. Construction of the vertical assembly building was started in mid-1963 and will require about two years. An industrial area was begun in early 1963 to support the Gemini program and will take about 18 months to complete; this area will be later expanded and used to support the Apollo program.

Supporting Missions. The Soviets have already begun to carry out missions which could support a manned lunar landing program. [redacted] Our knowledge of Soviet space programming is so imperfect that we have no basis for choosing among a number of possible explanations, ranging from a lack of urgency in acquiring the data to a desire on the part of the Soviets for more advanced hardware -- boosters, stages, spacecraft -- than that now available.



In the illustrative program, the Soviet maneuverable spacecraft would not have to be man-rated before 1966 In the Gemini program, which is intended to support the US manned lunar mission, the first launch is scheduled for the second quarter of 1964 with the first manned flight in late 1964 and the first rendezvous operation in the second quarter of 1965.

Development of re-entry technology for the return phase of the lunar mission has not been included in the illustrative program, but several alternative approaches to this problem are open to the Soviets. They may choose to use high angle re-entry utilizing atmospheric braking only (as in the US program), in which case the first observable flight test might occur in 1964. Alternatively, they may adopt a technique involving partial retro-braking prior to re-entry, which would reduce the heat shield performance requirement. Finally, if weight is not a constraint, they may elect to use retro-braking to get into earth orbit and then use proven re-entry techniques.

Launch Vehicle. Development of an early high energy stage is not essential to the accomplishment of subsequent milestones in the development of launch vehicle hardware for the lunar mission. If the Soviets choose to use hydrogen fuel in the upper stages of the launch vehicle, they would probably develop a smaller engine as a test bed, although this early engine would not have to be flight tested before the end of 1965. However, the Soviets may not be compelled to use hydrogen fuel to achieve a higher specific impulse; they may elect to use other propellent combinations or fuel additives for this purpose.

About 18 months have been allowed in the illustrative program for test firings of the launch vehicle, from the first firing of the booster to the first manned flight. This compares with about 15 months now scheduled for unmanned launches in the US program. The first and second

stages of the Soviet vehicles are estimated to be man-rated by 1968, while the third stage is man-rated by 1969, following which the manned lunar landing mission could be attempted.

Lunar Spacecraft. Flight tests of the lunar spacecraft stretch over a period of about 2.5 years prior to mission accomplishment. This compares favorably with the launch schedule for fully instrumented Apollo spacecraft, although five launches of Apollo boilerplate models are programmed during a period from about mid-1964 through mid-1965

Nevertheless, in the Category A ICBM, the Soviets probably already have a booster capable of launching boilerplate prototypes.

About a year has been allowed for rendezvous and docking operations using mission hardware before the earliest manned lunar landing attempt is scheduled. In the early Apollo program which utilized the EOR mode, a nine-month period was scheduled for this purpose.

III. Economic Considerations

A manned lunar landing program is very expensive; Khrushchev and others have expressed concern in the past over the high cost of such an undertaking. In considering whether to accept the US challenge in 1961, the Soviet leaders would have had to weigh carefully the benefits from such a program against those to be derived from alternative, competing uses -- both military and civilian -- of the same level of resources. Whatever the Soviet decision, however, it is unlikely to have been based solely on economic considerations. At least equally important would be the Soviet leaders' view of their ability to compete successfully and their assessment of the consequences for Soviet prestige and claims to great power status of default from the race.

Although we have no direct information on the costs of Soviet space programs, the estimated cost (produced-in-the-US) of the illustrative Soviet manned lunar landing program would be on the order of $15 billion to $20 billion through 1969. Peak expenditures on the order of $3 billion to $4 billion a year would probably be required in 1965-66.* Costs of this magnitude probably would have tended to dissuade the Soviet leaders from accepting the US challenge in 1961.

Nevertheless, in the past, the Soviets have been willing to allocate substantial resources to their space program, to which they have attached great importance as a means of projecting an image of military strength and technological superiority. Although they have done much to make their space program as economical as possible through the use of available military hardware and facilities, keeping unique vehicle development to a minimum, and through concentration on a limited number of major space objectives, Soviet accomplishments in space have come high. It is estimated that by the end of 1963, the Soviets had spent the equivalent of at least $3.0 billion and perhaps as much as $4.5 billion for those programs already in the flight test phase.

Additional expenditures for programs now underway, but not yet identified [redacted] may be on the order of $1.5 billion to $4.0 billion. Primarily, this range reflects our uncertainty concerning the Soviet timetable for a manner lunar landing. Because of leadtime constraints, a Soviet decision to compete would

* These figures exclude all other space programs except those required to support a manned lunar landing, such as lunar reconnaissance and early rendezvous and docking. They also exclude the costs which would be incurred during the latter part of the decade for subsequent lunar programs, such as the establishment of a lunar base.

have had to be made by mid-1962 and already would have entailed a substantial expenditure -- about $3.0 billion. Even if the Soviets decided not to compete, however, they must have made some initial investment in a future effort to land a man on the moon -- probably on the order of $1.0 billion.

Thus, estimated total Soviet space expenditures through the end of 1963 range from $4.5 billion to $8.5 billion. This compares with NASA expenditures for this period of about $7 billion and DOD space expenditures of about $5 billion, a total US space expenditure of $12 billion through the end of 1963.

There are numerous indications that the Soviets are committed to a vigorous space program in the next few years, involving new missions and new space systems, and there seems little doubt that Soviet expenditures for space are destined to grow. The KYMTR and TTMTR Cosmos programs are continuing [redacted] Moreover, the expansion in the number and size of launch complexes at TTMTR in the past few years has been so great that it cannot be accounted for entirely by new weapon systems programs. Some of the facilities now being built almost certainly are intended to support future space programs.

Even if the Soviets are not committed to a competitive manned lunar landing program, we would expect them to undertake several less costly, less spectacular missions in this decade in order to maintain their position as a great space power and their world image as a technologically advanced nation. There is a wide range of missions which could be accomplished with a more advanced booster, such as that currently estimated to be developed in the next few years as a delivery vehicle for the 100-megaton warhead. These missions probably would include early rendezvous and docking, a small earth-orbiting station, and a manned circumlunar flight. Because the cost of developing the booster would be borne by the military, such a package of programs could be purchased for an estimated expenditure of only $6 billion to $8 billion.

The next class of space missions would require a booster of much greater thrust which would have no immediate military application. The cost of developing this unique booster, therefore, would be attributable solely to the Soviet space program. Other than a manned lunar landing mission, the most likely mission in this decade that might employ such a booster is a large manned scientific satellite, the estimated cost of which ranges from $12 billion to $16 billion. Expenditures of this magnitude, however, verge on those estimated for the

illustrative manned lunar landing program ($15 billion to $20 billion). Moreover, a smaller manned space station could be established without the use of a very large and costly booster. Because the Soviets would probably consider that the lunar mission would be of greater value in maintaining their national image of preeminence in space, we believe that Soviet development of a very large booster in the near term, as seems to be implied by the size of the facilities now under construction between Complexes A and E at Tyuratam, would provide a strong indication that the Soviets intend to compete in a manned lunar landing mission.